International Journal For Technological Research In Engineering
Volume 7, Issue 12, August-2020 *ISSN (Online): 2347 - 4718*

OPTIMIZING THE STRENGTH OF RIGID PAVEMENT BY REPLACING CLASS F FLY ASH IN GEOPOLYMER CONCRETE BY COCONUT FIBER ASH

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ABSTRACT: Geopolymers are a type of inorganic polymer & light weight material that can be formed at room temperature with less energy losses by using industrial waste or by-products as source materials to form a solid binder. Geopolymer concrete is manufactured from utilization of waste material from industrial waste such as fly ash. Geopolymer concrete is a type of by which we can be used in applications to fully or partially replace OPC with environmental and technical alternative to Ordinary Portland Cement (OPC) based concrete. In the manufacture industry the creation of Portland cement causes the secretion of air pollutants which results in environmental contamination. It reduces 80 - 90% CO2 emissions. Coconuts fiber is collected from temples & shops and it is burn in open air then the ash obtained by coconut fiber ash is passed through 150 micron sieve. And then replacement of class f fly ash by coconut fiber fly ash replace 0%,to 1.5% and when it is increase from 1.5% i.e. up to 2% result obtained is decreasing in compressive strength.

Keywords: Fly ash, Ordinary Portland Cement (OPC), Coconuts fiber

I. INTRODUCTION

Coconuts fiber is collected from temples & shops and it is burn in open air then the ash obtained by coconut fiber ash is passed through 150 micron sieve. And then replacement of class f fly ash by coconut fiber fly ash replace 0%,to 1.5% and when it is increase from 1.5% i.e. up to 2% result obtained is decreasing in compressive strength

The color of fly ash may vary from tan to dark grey, depending upon the chemical and mineral constituents. The other characteristics of fly ash which are benefits, & its main aim to reduce carbon dioxide up to 80-90% and improved resistance to fire, impermeable and aggressive chemicals. Fly ash plays a vital role in Geopolymer concrete, and class f fly ash is used in construction purposes which contain 10% of lime also to replace the use of conventional ordinary Portland cement. The binding agent is the only difference to the ordinary Portland cement concrete because opc is responsible for high content of energy losses and it requires high temperature for manufacturing. To trigger the substance in fly ash, sodium hydroxide solution and sodium silicate solution was used in amalgamation. Advantage of geopolymer concrete is, it is non-toxic, it easily sets at room temperature, higher compressive strength, higher resistance to heat and resist to all inorganic solvent and sustainable generally considered are loss on ignition (LOI) which is the measurement of unburnt carbon remaining in the ash, fineness and uniformity

II. OBJECTIVES

The main object of the study is:-

i) To study on effect of Molarity of Additive Activator on Compressive Strength of Geopolymer Concrete (GPC) by replacing class f fly ash by fly ash of cocunut fiber

ii) To study the engineering properties of fresh and hardened Geopolymer Concrete.

iii) To utilize the waste materials available in the agro-industries.

For the research work utilised low calcium (class F) fly ash and fly ash of cocunutfiber as the base material for making Geopolymer Concrete (GPC) in which partial replacement of class f fly ash by with fly ash of cocunut fiber. The class f fly ash was obtained from the college laboratory & the cocunut fiber is obtained from locally available temples and shop of vidisha.. The tests currently available for Ordinary Portland cement concrete were used. As far as possible, the technology and the equipment currently used to manufacture OPC concrete were also used to make GPC.

DATA FOR THE DESIGN OF GEOPOLYMER CONCRETE MIX

In order to determine the alkaline liquid and the fly ash required for prepare the mixture, The ratio of alkaline liquid to fly ash by mass in needed.

Table shows the data used for finding the ratio of alkaline liquid to fly ash ratio.

Alkaline liquid / Fly ash, by mass	Water / geopolymer solids, by mass	Workability	Design compressive strength (MPa)
.30	.16	Stiff	60
.35	.18	Moderate	50
.40	.2	Moderate	40
.45	.22	High	30

The NaoH with 97-98 % purity is commercially accessible. The solid must be dissolved in water to make a solution with required concentration. The concentration of sodium hydroxide can varies in the range between 8 molar to 16 molar. The mass of the sodium hydroxide solid is depending on the concentration of the solution. For instance Sodium hydroxide solution with a concentration of 8 Molar consist of 8x40=320 gram of NaOH solid per litre of the solution, where 40 is the molecular weight of NaOH. The mass of NaOH solid was measured is 262 gram per kg of NaOH solution with a concentration of 8 Molar. Similarly, the mass of NaOH solid is per kg of solution for other concentrations

is measured and expressed in percentage.
Percentage of NaOH flake in various molarity.

NaOH solution	Percentage (%)
8 M	26.23
10 M	31.37
12 M	36.09
14 M	40.43
16 M	44.44

LABORATORY WORK
• Proporting
• Mixing
• Casting
• Curing

Proporting:-
Table 5.1 the design mix of preparation of 48 no of cubes of size 15cm x15cm x 15cm.

Geopolymer mix			
Material	**Unit**	**Quantity**	
Fly ash	kg	72	
Aggregates	20 mm	kg	120
10 mm	kg	96	
Sand	kg	96	
Alkaline activator	Chemical activator-I (NaOH)	kg	12
Chemical activator-II (Na2SO3)			
Water	lts	16	
Percentage of Coconut fiber fly ash 0.5% coconut fiber fly ash 1% coconut fiber fly ash 1.5% Coconut fiber fly ash 2% coconut fiber fly ash	gram gram gram gram	90 180 270 360	

Mixing: -
Raw materials i.e. fly ash, coarse aggregate and sand was weighted manually according to the design mix. Then materials were mix sequence in the pan and hand mixing was done. After the mixture achieved their homogeneity, the alkaline solution was added gradually in the mix. Mixing was continued for further 20 minutes or until it develops a uniform mix. The fresh mix was first tested for workability by means of Slump Cone Test & then poured into the moulds.

Casting: -
The fresh concrete is poured in moulds and compressed. Further compaction was done by vibrating machine. The procedure of mixing and casting is similar to cement concrete cubes. Total 48 No. moulds of size 150mm X 150mm X 150mm is prepared.

Curing:-
There are two types of curing

• Ambient Curing: - In ambient curing after casting the specimen were left to air for desire period
• Oven Dry Curing:- In oven dry curing the specimen were cured in oven after that the specimen were left to air dry in the laboratory for the next 6 ,13 ,20,and 27 days and the testing is done on 7, 14 ,21 and 28 days.

The test specimens are stored in oven at 60 C for 24 hours. After that the specimen are removed from the mould and marked and kept in air for desire period this duration will be different in all four cases. After that the cubes are tested at the scheduled time.

CASTED CUBE:

Procedure for compressive Strength Test of Geopolymer Concrete Cube

• Lift the specimen from laboratory floor or outside after specified age and wipe out any dirt from the surface.
• The bearing surface of the test machine must be clean.
• Place the sample in the machine in such a way that the load must be applied to the conflicting sides of the cube cast.
• Line up the specimen centrally on the bottom plate of the machine.
• Rotate the variable portion smoothly by hand so that it touches the top face of the specimen.
• Apply the load slowly and steadily without shock and continuously at the rate of 140kg/cm2/minute till the specimen or cube fails.
• Note the highest load and it should also be noted that any unusual features in the type of failure must not occur.

Note:-
Minimum three cubes must be tested at each chosen age. Average of three specimens gives the crushing strength of mortar i.e. the strength requirements of mortar.
Calculations:-
Size of the cube =15cm x15cm x 15cm.
Load on failure in KN = ……
Compressive strength at …. Days = Load in N/ Area in mm2=……N/mm2 or MPa

III. RESULT AND ANALYSIS

In one batch total 48 numbers of cubes were casted. All the cubes were thermal cured or oven cured at 60C for 24 hours. Average Compressive Strength of Geopolymer Concrete cube is consider of thermal cured at 60 C for 24 hrs.and after that left at ambient at room temperature. Geopolymer Concrete cubes of Morality 14 M of Additive Activator at 7, 14, 21 and 28 days

Table show the average compressive strength of GPC cube

AVERAGE COMPRESSIVE STRENGTH OF CONCRETE AT 0.5 %

Compressive strength					
Days	**S.No.**	**Weight of cube in kg**	**Load in KN**	**Strength in MPa**	**Average strength in MPa**
7 days	1	8.2	710	31.55	30.91
	2	7.93	700	31.11	
	3	8.4	690	30.07	
14 days	1	7.83	705	31.33	31.33
	2	7.90	710	31.55	
	3	8.1	700	31.11	
21 days	1	7.8	730	32.44	32.66
	2	8.0	725	32.22	
	3	8.3	750	33.33	
28 days	1	8.1	765	34.00	33.77
	2	7.8	745	33.11	
	3	8.0	770	34.22	

AVERAGE COMPRESSIVE STRENGTH OF CONCRETE AT 1%

Compressive strength					
Days	**S.No.**	**Weight of cube in kg**	**Load in KN**	**Strength in MPa**	**Average strength in MPa**
7 days	1	8.1	715	31.78	32.15
	2	8.3	730	32.44	
	3	8.0	725	32.22	
14 days	1	7.9	735	32.66	32.73
	2	7.88	730	32.44	
	3	8.3	745	33.11	
21 days	1	8.23	785	34.89	33.93
	2	8.20	735	32.67	
	3	8.0	770	34.22	
28 days	1	8.1	780	34.67	35.04
	2	8.3	795	35.33	
	3	8.1	790	35.11	

AVERAGE COMPRESSIVE STRENGTH OF CONCRETE AT 1.5%

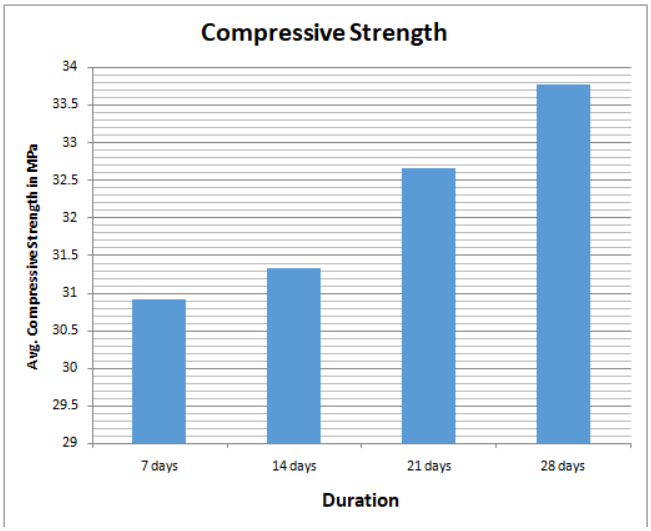
Compressive strength					
Days	**S.No.**	**Weight of cube in kg**	**Load in KN**	**Strength in MPa**	**Average strength in MPa**
7 days	1	7.9	770	34.22	34.07
	2	8.1	760	33.77	
	3	8.0	770	34.22	
14 days	1	8.3	815	36.22	35.93
	2	8.2	810	36.00	
	3	8.1	800	35.55	
21 days	1	8.2	840	37.33	37.41
	2	8.3	850	37.78	
	3	8.1	835	37.11	
28 days	1	7.9	850	37.78	37.85
	2	8.0	845	37.55	
	3	7.9	860	38.22	

AVERAGE COMPRESSIVE STRENGTH OF CONCRETE AT 2%

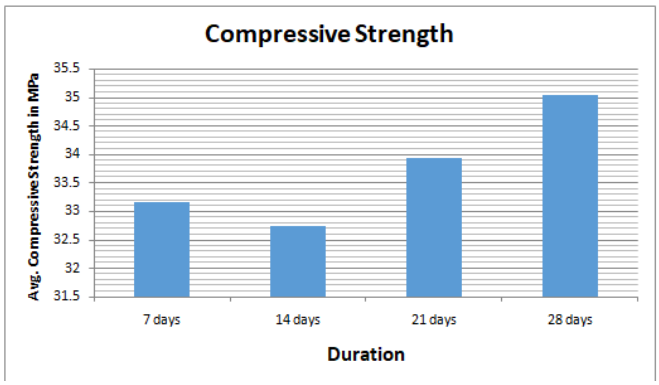
Compressive strength					
Days	**S.No.**	**Weight of cube in kg**	**Load in KN**	**Strength in MPa**	**Average strength in MPa**
7 days	1	8.1	640	28.45	29.18
	2	8.2	680	30.22	
	3	8.0	650	28.88	
14 days	1	7.88	690	30.67	29.92
	2	8.0	680	30.22	
	3	8.23	650	28.88	
21 days	1	7.9	725	32.22	32.15
	2	8.0	730	32.44	
	3	7.9	715	31.78	
28 days	1	8.1	745	33.11	33.48
	2	7.88	750	33.33	
	3	8.0	765	34.00	

GRAPH OF COMPRESSIVE STRENGTH:

GRAPH OF COMPRESSIVE STRENGTH 0F 0.5%



GRAPH OF COMPRESSIVE STRENGTH OF 1%



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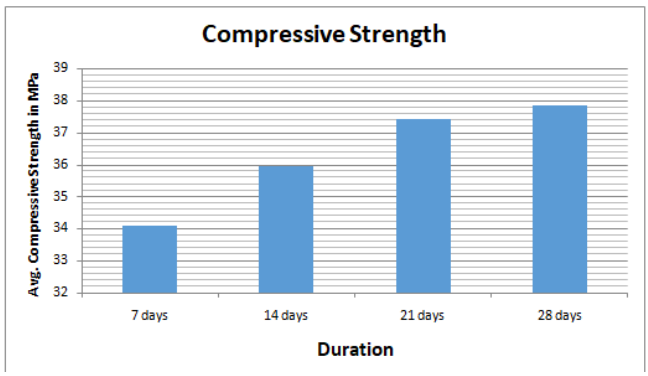

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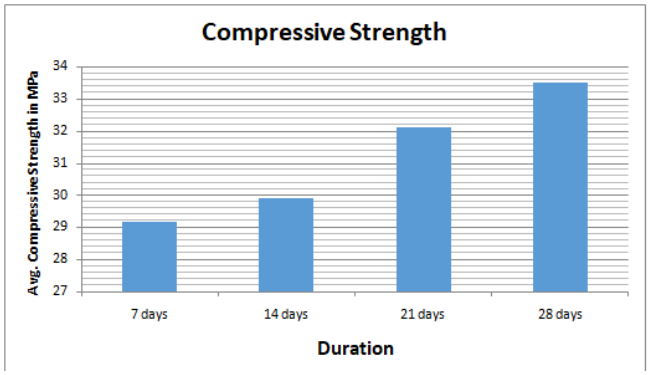

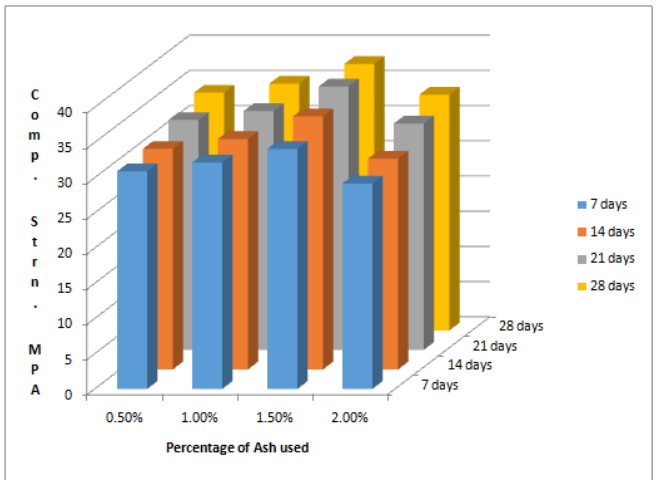

Comparison chart

FINAL RESULTS

• The Fly Ash used in this dissertation is Class F Fly Ash.
• Coconut fiber fly ash was obtained by flaming coconut fiber and passed the same through the 150 micron sieve.
• The purpose of this dissertation was to use the Geopolymer concrete for the construction of RIGID PAVEMENT BY USING COCUNUT FIBER FLYASH.
• The fly ash which is used in experimental work that is obtained from the college laboratory and coconut fiber is obtained from locally available temple and shops.
• The Alkaline activator solution of molarity M14 is prepared.
• The Geopolymer Concrete was made up of Additive Activator, Fly Ash, Coarse and Fine aggregate and coconut fiber fly ash with different proportion.
• Concrete cubes 48 in number were casted and after that it is cured in oven at 60oC for 24 hours for thermal curing. The cubes of concrete was tested at 7, 14 , 21 and 28 days in compression testing machine. The results were shown in table

IV. CONCLUSION

- Geopolymer concrete is activated by sodium silicate and sodium hydroxide, since the molarity of NAOH increases the compressive strength also increases, if percentage of coconut fiber increases up to 1.5%, increase in compressive strength is noted but after 2% compressive strength decreases.
- Curing can be done in two format i.e. an in ambient curing and oven drying curing ,we have done oven drying curing at 60^{o}C
- Among all coconut fiber should have strain of 4-6 % more than other fiber.
- With the increase in moisture content the workability also enhances.
- The rest phase for the fresh fly ash based geopolymer concrete is between 2 to 3 days.
- Coconut fiber should have good durability and abrasion resistance characteristics.
- If cellulose content of coconut fiber increases then compressive strength decreases.

- High lignin content as it has high resistance to different weather and therefore coconut fiber is suitable material for construction of road.
- The handling time of fresh geopolymer concrete is upto 2 hours.
- The age of concrete has no effect on the compressive strength of geopolymer concrete.

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